



PATENT SPECIFICATION

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COMPLETE SPECIFICATION

Method of Fabricating a Structural Unit

- We, SHELL INTERNATIONALE RESEARCH MAATSCHAPPIJ N.V., a Company organised under the Laws of the Netherlands, of 30 Carel van Bylandtlaan, The Hague, The Netherlands, do hereby declare the invention, for which we pray that a patent may be granted to us and the method by which it is to be performed, to be particularly described in and by the following statement:—
- This invention relates to a method of fabricating structural units, more particularly but not exclusively for hydraulic purposes, e.g. for the construction of dykes, dams, breakwaters and jetties.
- Such hydraulic works are usually subject to the heavy breaking of waves, so that measures are taken to eliminate so far as possible the effect of the breakers on the structures, e.g. by lining them with basalt or concrete blocks. In deep water, or at places where heavy breakers may be expected, such provisions will not always be sufficient. In such cases the structures are usually reinforced by means of a more or less compact pile of large natural rocks or structural units in the form of concrete blocks. The structural units have been fairly widely used in the form of so-called tetrapods, e.g. in the construction of jetties in relatively deep water.
- Since there is an increasing need of hydraulic structures of this kind, a demand has arisen for heavy structural units; it should still be possible to put them in position without difficulty and also to fabricate them readily in situ, or at any rate in the immediate vicinity of the work, from a plentiful supply of base materials. Another requirement is that the structural units should not be too costly.
- One of the most important requirements which such structural units should fulfil is the possibility of rapid fabrication; if fabrication is a relatively slow process the work is held up and costs rise.
- It is an object of the invention to provide a method of fabricating structural units which fulfils the requirement of rapid fabrication.
- According to the invention a method of fabricating structural units comprises filling a mould with a bituminous composition by pouring coarse stones as hereinafter defined and a mixture of bitumen and sulphur having a temperature of from 120 to 160°C into the mould, then allowing the contents of the mould to cool down to a temperature lower than 120°C, and subsequently releasing the contents from the mould.
- The structural units made by the method of the invention have the property of eventually becoming deformed under their own weight after being placed in position, thereby assisting the cohesion of continuous or superimposed structural units.
- The temperature of the mixture must not exceed 160°C as otherwise a reaction occurs between the bitumen and the sulphur. The lower temperature limit (120°C) is determined by the melting point of sulphur.
- The temperature at which the mass is released from the mould is measured in the bituminous composition, between the coarse stones, at about 20 cm from the wall of the mould.
- By coarse stones is meant stones having dimensions greater than 50 mm, the maximum size being determined by practical considerations. Coarse stones having dimensions of from 50 to 500 mm are preferred, this material being extremely suitable for the purpose and relatively inexpensive.
- In addition to bitumen, coarse stones and sulphur, also a mineral aggregate may be used in the bituminous composition from which the structural units are made.

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Mineral aggregate comprises a mixture of stones having dimensions less than 50 mm, sand and/or filler.

5 Compositions which contain asphaltic bitumen, sulphur and mineral aggregate and are prepared at a temperature between 120 and 160°C are known from United States Patent Specification No. 2,182,837. The compositions referred to in that patent specification, however, contain no coarse stones as herein defined, nor is there any mention of a use of the resultant compositions in the field of hydraulic engineering.

10 If the sulphur were omitted from the bituminous composition the structural unit obtained would be very difficult to use. A structural unit of that type generally would need a long time to cool to such a temperature that it would not become unduly deformed after release from the mould. However, if sulphur is added it separates in solid form from the bitumen on cooling so that the viscosity of the mass is greatly increased and the desired mechanical stability is reached even at about 100°C. There is therefore no need to wait until the mass has cooled to 40°C, for example, and the structural unit can be released earlier from the mould at 80 to 100°C, for example.

15 The amounts of the ingredients making up the bituminous composition may vary within wide limits.

20 Use is generally made of 1 to 10 parts by weight, preferably 3 to 7 parts by weight, of bitumen. If ordinary mineral fillers are also used, e.g. in the form of materials such as ground limestone or ground shale, 1 to 20 parts by weight, preferably 3 to 10 parts by weight, are generally used. If sand is also added, e.g. dune sand, river sand or crusher sand or mixtures thereof, 1 to 25 parts by weight, preferably 5 to 20 parts by weight, generally employed. If small stones are added, two types can advantageously be used. viz. firstly, stones with dimensions of from 2 to 20 mm and secondly stones with dimensions of from 20 to 50 mm, in which case 1 to 35 parts by weight, preferably 5 to 25 parts by weight, are generally employed of the first type, and 1 to 25 parts by weight, preferably 10 to 20 parts by weight, of the second type are generally used.

25 Of the coarse stones with dimensions exceeding 50 mm, in particular those with dimensions of from 50 to 500 mm, generally 30 to 70 parts by weight, preferably 40 to 60 parts by weight, are used. Of the sulphur generally 1 to 10 parts by weight, preferably 1 to 7 parts by weight, are employed.

30 The above parts are per 100 parts by weight of the bituminous composition.

35 The addition of sulphur also makes it possible to use an asphaltic bitumen with a higher softening point than is possible without the sulphur, which is an advantage since

an asphaltic bitumen with a higher Ring-and-Ball value will produce greater solidity in the block on cooling to the temperature at which the mass is released from the mould than an asphaltic bitumen with a lower Ring-and-Ball value.

70 The same effect cannot be achieved by directly adding a larger amount of an ordinary mineral filler, since in that case the bituminous composition becomes difficult to work, a sufficiently cohesive whole is not obtained and as a result the structural unit formed cannot be used in practice.

75 The bitumen used can be any asphaltic bitumen generally used for road building. Tar and pitches can also be used, as well as mixtures of tar and asphaltic bitumens. Mixtures of asphaltic bitumens and heavy hydrocarbon oils can also be used. Asphaltic bitumens of the blown type are also suitable, and natural bitumens such as Trinidad Lake asphalt can also be used.

80 If desired, after the bituminous composition has been placed in the mould, it may be mechanically compacted.

85 The following *modus operandi* can be followed for fabricating the structural units according to the invention:

EXAMPLE

90 Two parts by weight of sulphur, if desired liquefied, are added at 150°C to 5 parts by weight of asphaltic bitumen (penetration: 80/100).

95 This asphaltic bitumen/sulphur mixture is added to a mixture consisting of 5 parts by weight of filler, 15 parts by weight of sand, 10 parts by weight of small stones (2—20 mm) and 13 parts by weight of small stones (20—50 mm). One must ensure that the temperature of the asphaltic concrete thus obtained is not lower than 120°C or higher than 160°C. A stream of the asphaltic concrete obtained is then led simultaneously with a stream of coarse stones (50—500 mm), equal weight ratios, into a mould consisting of steel plates, the measurements of the mould being 2 × 2 × 2 metres. The mould and contents are then transported to the construction site. After a short time (in all about 15—30 minutes from the time of filling the mould) the structural unit has sufficient mechanical stability to allow it to be released from the mould.

100 The structural unit may also be fabricated in various modified ways. Thus the method described in the above Example can be adopted, or the sulphur may first be added in finely divided form to the mineral filler or to the filler/sand mixture prior to the manufacture of the asphaltic concrete from bitumen, small stones, sand and filler; or a stream of sulphur in finely divided or liquid form and a stream of bitumen can be passed separately into the mixture of filler, sand and small stones. It is also possible to fill the mould

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with a premixed bituminous composition, comprising coarse stones, bitumen and sulphur and having a temperature within the range of from 120 to 160°C, the composition having been made, for instance, by mixing all the components in a mixing device with heating.

The structural units according to the invention are also suitable for use in constructing bridges, locks, retaining dams, railway embankments and the like.

WHAT WE CLAIM IS:—

1. A method of fabricating structural units which comprises filling a mould with a bituminous composition by pouring coarse stones as hereinbefore defined and a mixture of bitumen and sulphur having a temperature of from 120 to 160°C into the mould, then allowing the contents of the mould to cool down to a temperature lower than 120°C, and subsequently releasing the contents from the mould.

2. A method as claimed in claim 1 in which the mould is filled with a premixed bituminous composition comprising coarse stones as hereinbefore defined, bitumen and sulphur, the composition having a temperature within the range of from 120 to 160°C.

3. A method as claimed in claim 1 or claim 2, in which the coarse stones have dimensions from 50 to 500 mm.

4. A method as claimed in any of claims 1 to 3 in which the coarse stones are used in 30 to 70 parts by weight per 100 parts by weight of the bituminous composition.

5. A method as claimed in any of claims 1 to 4 in which the bitumen is used in 1 to 10 parts by weight per 100 parts by weight of the bituminous composition.

6. A method as claimed in any of claims

1 to 5 in which the sulphur is used in 1 to 10 parts by weight per 100 parts by weight of the bituminous composition.

7. A method as claimed in any of claims 1 to 6 in which the bituminous composition also comprises a mineral aggregate.

8. A method as claimed in claim 7 in which the mineral aggregate comprises stones having dimensions less than 50 mm and/or sand and/or filler.

9. A method as claimed in claim 8 in which the aggregate comprises 1 to 35 parts by weight of stones having dimensions of from 2 to 20 mm and 1 to 25 parts by weight of stones having dimensions of from 20 up to 50 mm per 100 parts by weight of the bituminous composition.

10. A method as claimed in claim 8 or claim 9 in which the aggregate comprises 1 to 25 parts by weight of sand per 100 parts by weight of the bituminous composition.

11. A method as claimed in any of claims 8 to 10 in which the aggregate comprises 1 to 20 parts by weight of filler per 100 parts by weight of the bituminous composition.

12. A method as claimed in any of the claims 1 to 11 in which the content of the mould is allowed to cool down to a temperature between 80 to 100°C.

13. A method of fabricating a structural unit substantially as described in the Example.

14. Structural units for hydraulic purposes fabricated by a method as claimed in any of claims 1 to 13.

15. Hydraulic works constructed with the use of structural units as claimed in claim 14.

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